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BEFORE
THE ROYAL COMMISSION
ON
ENERGY

A
SUBMISSION BY
THE BRITISH AMERICAN OIL COMPANY LIMITED
AT
CALGARY, ALBERTA
FEBRUARY, 1958

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THE BRITISH AMERICAN OIL COMPANY LIMITED

SUBMISSION

TO THE ROYAL COMMISSION ON ENERGY

In the following submission our comments will be restricted to matters of fundamental concern to British American as a natural gas producer. At a later date we would welcome the opportunity to present our views on other subjects within the scope of the Commission's inquiry.

RECOMMENDED GAS EXPORT POLICY

In our opinion the policy that will best serve the national interest, in relation to the export of gas as an energy source, is one permitting the immediate export of quantities determined to be surplus to the foreseeable needs of Canada. The future requirements of Canada should be of paramount importance in determining the quantities of gas available for export.

This recommendation is based on the following conclusions:

1. Canada has, and will continue to have, exportable quantities of gas surplus to her own future requirements. Surplus quantities should be determined by relating future requirements to future reserve trends.

2. A policy permitting the immediate export of available surplus, by providing the necessary incentive for the development of existing reserves and the discovery of new reserves, is the best way of ensuring that adequate reserves will be developed to meet future national requirements.

3. The continued growth of the industry will require heavy capital expenditures in the search for new reserves, in the development of existing reserves, and in the construction of processing plants and related

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facilities. Markets must be made available to attract the capital required for this growth.

4. The demand for natural gas in Canada, in relation to the reserves presently available and to be discovered, does not provide adequate incentive for continued gas exploration and development. Markets outside Canada are required now to avoid a serious setback to the continued expansion of the industry.

5. The steady growth of the natural gas industry will have far-reaching beneficial effects on the overall economy of Canada. The development of export markets for gas will assure the continued flow of funds into the economy for further expansion, creating additional employment and materially assisting Canada's balance of trade position.

BRITISH AMERICAN'S POSITION IN THE INDUSTRY

British American is a major holder of gas reserves in Canada, and has been concerned for many years with the problems relating to the production and disposition of natural gas.

To illustrate how essential export markets are to the industry, we feel it would be helpful to the Commission to describe British American's position and to demonstrate the importance of this subject to its operations.

British American has a proven marketable reserve of natural gas of three trillion cubic feet located in fields throughout Western Canada. This reserve represents an investment at Dec. 31, 1957, of $48.6 million in gas wells and properties, gathering systems, processing plants, and related facilities. A further $22 million expenditure is planned for 1958. To date, British American has received $854,000 of net income from this investment. Fifty per cent of this reserve is committed to pipe lines presently under construction or in operation. The remaining reserve is awaiting markets.

While British American has this direct interest in the development of export markets, we also believe it is in the interests of the natural gas industry and of the overall Canadian economy that immediate markets be found for the available surplus.

WESTERN CANADA HYDROCARBON RESERVES

A. Ultimate Reserves in the Western Canada Sedimentary Basin

For the purposes of this submission, ultimate recoverable reserves of hydrocarbons for Western Canada have been determined by a volumetric method, using for comparison the Mid-Continent area of the United States, where the types of sediments, types of entrapment, and total geological column are similar. The Western Canada Sedimentary Basin is within the same geological province as the Mid-Continent area, which includes such prolific regions as Texas (exclusive of the Gulf Coast), Oklahoma, Kansas, Eastern New Mexico, Eastern Colorado, and Eastern Wyoming.

Estimated virgin reserves for the Western Canada Sedimentary Basin recoverable by primary methods are as follows:

	Ultimate Reserves
Crude Oil (billions of bbls.)	48
Producible Gas (trillions of cubic feet)	308
Natural Gas Liquids including Condensate (billions of bbls.)	6.3

For derivation of the ultimate reserves, each portion of the Western Canada Sedimentary Basin has been analyzed separately. We are of the opinion that these ultimate recoverable reserves are conservative, and will be increased as the quality of exploration and recovery methods are improved. Further particulars with respect to this estimate are contained in the Appendix.

B. Present Reserves

British American has prepared the following estimate of the present proven and probable oil, gas, and natural gas liquid reserves of Western Canada:

	Present Reserves (Proven & Probable)
Crude Oil (billions of bbls.)	3.7
Producible Gas (trillions of cubic feet)	28.591
Natural Gas Liquids including Condensate (billions of bbls.)	0.595

The gas reserves referred to above are on a producible basis, and have been computed by including raw separator gas for dry gas fields and solution gas fields where product recovery facilities are presently available or in course of construction. For wet gas fields, where extraction facilities are anticipated within the next few years, the raw separator gas has been shrunk for the liquid product expected to be obtained from plant operations. To obtain marketable or pipe line gas, it is necessary to deduct from the producible gas reserve, plant and lease fuel requirements, line losses and reserves considered not readily accessible to markets.

The above estimates were prepared for verification purposes. Inasmuch as the estimate of gas reserves agrees within 6 per cent of the corresponding Canadian Petroleum Association estimate of proven and probable gas reserves, and since the latter estimate was prepared on the basis of geological and engineering data not available to British American, we endorse the C.P.A. estimate.

The present marketable gas reserves in Western Canada are considered to be 27.5 trillion cubic feet. This figure has been derived by taking the proven and probable producible gas reserve of 30.2 trillion cubic feet as reported by the C.P.A. and applying an appropriate reduction for conversion to marketable gas.

GROWTH OF RESERVES AND CONSUMPTION OF GAS

We intend to demonstrate to the Commission that the relationship between the growth in reserves and the growth in consumption provides a realistic basis from which a sound gas export policy can be derived.

Reserve Growth

In the Appendix it is shown that by pursuing an exploration program involving the drilling of an average of 1,000 exploratory wells per year, a virgin producible gas reserve of 150 trillion cubic feet can be discovered and developed in Canada by 1982. This reserve represents approximately 134 trillion cubic feet of marketable gas.

Exhibit I shows for both Canada and the United States the average annual reserves discovered over five-year periods. The data are shown in tabular form in Exhibits III and IV. In Canada between 1951 and 1955 the average annual increase in reserves has been 2.8 trillion cubic feet,[1] accomplished without extensive wildcat drilling for gas and in the absence of incentive for development.

We are confident that with the incentive for exploration and development that will come from export markets, the discovery rate and annual growth in reserves will show a very marked increase. The reserve growth, resulting from exploration and development, need reach only 4.4 trillion cubic feet per year by 1965 and remain constant thereafter, in order to attain a virgin marketable reserve of 134 trillion cubic feet by 1982.

Exhibit I also shows clearly that the stimulus of an increasing annual demand, such as has been experienced in the United States, will result in a marked increase in the rate of discovery. Over the period 1920 to 1957, demand for gas in the United States increased over tenfold — from 0.76 trillion cubic feet per year to 10.36 trillion cubic feet per year.[2] Over this same period, the average annual increase in reserves multiplied over twenty times — from 0.76 trillion cubic feet in 1920 to 22.65 trillion cubic feet in 1957.

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1 For references see Exhibit IV.

2 For references see Exhibit III.

The experience of the United States in reserve growth over the period 1920 to 1957 indicates clearly that the projected growth of gas reserves for Canada from 1957 to 1982 is conservative.

Exhibit II shows the cumulative growth of Canadian and United States reserves. Virgin marketable gas reserves in Canada have increased from approximately 2 trillion cubic feet, following the development of the Turner Valley Gas Field in Alberta in 1924, to 21.6 trillion cubic feet at the end of 1955.[1] The reserve of marketable gas to be discovered by 1982 of 134 trillion cubic feet is, of course, only a portion of the ultimate Canadian gas reserve.

The estimated gas reserves and consumption of gas in Canada at the end of 1957 are as follows:

Remaining Reserve	27.5	trillion cubic feet
Cumulative Consumption	1.7	trillion cubic feet
Annual Consumption	0.180	trillion cubic feet per year

Consumption Growth

The growth of consumption of gas in Canada and the United States is shown in Exhibits I and II. Exhibit I shows the average annual consumption over five-year periods. Exhibit II shows the cumulative growth.

It will be noted from Exhibit II that cumulative consumption of natural gas in Canada is expected to increase from 1.7 trillion cubic feet in 1957 to 27.8 trillion cubic feet in 1982, the difference of 26.1 trillion cubic feet representing the estimated total requirements of Canada and authorized export projects to the United States over the period.

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[1] For reference see Exhibit IV.

This estimate is shown in detail in the following table[1]:

	Total Requirements 1958 - 1982 (trillion cubic feet)	
Canadian Markets		
Alberta	6.16	
Saskatchewan (from Medicine Hat and local fields)	0.52	
Eastern Canada, Saskatchewan and Manitoba via Trans-Canada	12.21	
British Columbia via Westcoast	2.71[2]	
Total Canada		21.60
Exports to United States		
Canadian Montana (authorized)	0.27	
Westcoast (authorized)	2.50	
Trans-Canada (proposed)	1.75	
Total Export to United States		4.52
Total Canadian and Export		26.12

1 *References*:

(i) "Natural Gas Resources of the Province of Alberta and Other Related Data" - Oil and Gas Conservation Board, Province of Alberta, January 31, 1957.

(ii) "Present and Potential Canadian and Export Natural Gas Markets of Trans-Canada Pipe Lines Limited" - Commonwealth Services Inc., New York, February, 1958.

(iii) The Submission of Westcoast Transmission Company Limited to the Royal Commission on Energy, February, 1958.

2 Westcoast Transmission Company Limited data to 1962; British American estimate thereafter.

Relationship Between Supply and Demand

Our studies indicate that about four times as much gas will be discovered during the next 25 year period as will be required to meet the total Canadian demand and presently authorized export to the United States during those years.

The fact that growth in demand for gas will stimulate the development of new gas reserves is clearly demonstrated by an analysis of the trends in the growth of gas reserves and demand for gas in the United States.

We believe that the stage that has been reached in the development of gas reserves in Canada closely parallels that of the United States in 1920.

In 1920 remaining gas reserves in the United States were 15 trillion cubic feet as compared with 27.5 trillion cubic feet in Canada at the end of 1957. Consumption of gas in the United States in 1920 was 760 billion cubic feet[1], or exactly equivalent to the then current rate of growth of reserves. The life of the remaining gas reserves in 1920 in the United States was 20 years, computed on the basis of the then current consumption rate, and the remaining gas reserves in 1957 in the United States was 24 years.

The 1920 consumption rate of 760 billion cubic feet per year is comparable to the demand for Canadian gas in 1960 following the necessary build-up periods. The life of the remaining Canadian gas reserves in 1960 is estimated to be 58 years.

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1 For reference see Exhibit III.

The following table summarizes the data presented in graphical and tabular form in the Exhibits relating to this section.

	U.S. (Actual) 1920-1957		Canada (Projected) 1958-1982	
	Start of Period	End of Period	Start of Period	End of Period
Annual Growth				
Growth of Gas Reserves (trillions of cubic feet per year)	0.76	22.7	2.3	4.4[1]
Annual Demand (trillions of cubic feet per year)	0.76	10.4	0.18	1.5
Average Annual Demand (billions of cubic feet per day)	2.1	28	0.36	4.1
Cumulative Growth				
Virgin Marketable Gas Reserves (trillions of cubic feet)	17	389	29.2[2]	134
Cumulative Demand (trillions of cubic feet)	2	141	1.7	27.8
Remaining Marketable Gas Reserves (trillions of cubic feet)	15	248	27.5	106.2
Life				
Life (Rem. Reserve/ Current Prod. Rate) Yrs.	20	24	153	71

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1 It is assumed that the annual growth in gas reserves for Canada will increase gradually from 2.3 trillion cubic feet per year in 1958 to 4.4 trillion cubic feet per year in 1965, and remain constant thereafter.

2 The virgin marketable gas reserve figure of 29.2 trillion cubic feet does not include an estimated 1.3 trillion cubic feet of flared gas.

NEED FOR MARKETS TO ASSURE CONTINUING GROWTH OF THE INDUSTRY

The petroleum industry in Canada, including both oil and gas, has now reached a critical stage in its development.

Included as Exhibit V is our estimate of the industry's investment and realization from production for the period 1947 to 1957. The total expenditures by the industry in oil and gas properties during this period have been $3.2 billion of which only $1.9 billion has been recovered to date, so that expenditures to date have exceeded income by $1.3 billion.

In 1957, the industry expended in exploration, development and producing operations $547 million, and received, after royalty, income of $400 million, or $147 million less than the amount expended during the year. An excess of expenditure over income has occurred annually since 1947 and has necessitated the attraction of additional new capital each year.

Some indication of the task confronting the petroleum industry in supplying Canada's future energy needs can be taken from the fact that in 1953, 44 per cent of energy requirements were supplied by oil and gas, and in 1980 it has been estimated that 59 per cent will come from these sources.[1] The magnitude of this task in financial terms dwarfs the substantial investment made to date in oil and gas development.

Provided markets develop in an orderly manner, we estimate that in the next ten years the industry in Western Canada will spend $3.3 billion in exploration, $3.1 billion in development and $1 billion in gas gathering and processing facilities, for a total outlay of $7.4 billion. It must again be emphasized that this program is contingent to a large extent on the development of markets which will provide the funds for this expansion.

Virtually all of the industry's income to date has come from oil. Gas has contributed only 3.4 per cent of the total income realized from oil and gas production in the last ten years.

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1 "Canadian Energy Prospects" prepared for the Royal Commission on Canada's Economic Prospects, by John Davis, March, 1957.

It must be recognized that there is a high element of risk associated with oil and gas exploration. An additional consideration is the uncertainty of markets, which are essential to the development of gas reserves. This is especially significant in the case of certain gas fields which require the expenditure of very large amounts for processing plants before the gas can be made available for market. It is, therefore, imperative that markets be assured with the prospect of a reasonable return on investment before these expenditures can be undertaken.

The immediate problem confronting the industry today is the development of gas markets that will provide a return on the large frozen investment made to date and furnish the funds necessary to carry on with the further development of Canada's gas resources.

It is inevitable that if present available export markets are denied, a re-appraisal of the industry's overall exploration program must follow. The probable result will be some deferment of planned projects together with a shifting of emphasis in exploration activity away from areas where gas is likely to be encountered. This could cause serious dislocation in the development of both oil and gas reserves, adversely affecting not only the petroleum industry but the overall economy as well.

POLICY FOR THE UTILIZATION OF CANADIAN GAS RESERVES

Heretofore in determining volumes of gas surplus to requirements, it has been the practice to relate future needs for an extended period to proven reserves as at a particular time. In our opinion this approach is an erroneous one, which if continued will serve to delay unduly the disposition of gas reserves. Any such delay will, in turn, most certainly have an adverse effect on the intensity of gas exploration and development.

We believe that the geological environment of Western Canada is highly favourable to the discovery of ample reserves to supply Canada's own future needs with large volumes available for export, provided there is a market incentive for the development of these reserves. The additional reserves, which will be found for any given scale of exploratory effort, can be estimated with no less a degree of accuracy than future consumption. We are, therefore, firmly of the opinion that in determining the disposition of present reserves, future needs should be related to potential growth in reserves.

Illustrations of the inherently conservative nature of proven reserve estimates and the fallacy of relating future needs solely to present proven reserves are set forth in the following paragraphs.

An examination of the gas reserve estimates of the Alberta Oil and Gas Conservation Board for the years 1950 to 1957 indicates that with each succeeding year's report, gas reserves associated with discoveries reported the previous year have invariably increased.

For example, reserves from new discoveries for the years 1951 to 1956, as compared with the reserves assigned these fields in 1957, is given in the following table:

Year	Gas Reserves Discovered During Year	Gas Reserves from Discoveries in Col. (2) As Seen in 1957	Increase in Originally Assigned Reserves
	(trillions of cubic feet)		
1951	0.2	1.9	1.7
1952	1.4	1.9	0.5
1953	1.1	3.9	2.8
1954	0.6	1.8	1.2
1955	0.4	0.8	0.4
1956	0.6	1.3	0.7
Total	4.3	11.6	7.3

Just as the proven gas reserve does not represent the true potential of fields currently being developed, neither does it represent the potential of the large number of single-well gas fields in Western Canada today. Of some 700 capped gas wells in Western Canada, an estimated 200 are associated with a like number of single-well gas fields which have remained completely undeveloped to date. The proven reserves assigned to these wells have been on the basis of the standard spacing unit of one section, in accordance with recognized practice.

British American has an interest in 38 such single-well gas fields, the proven reserves of which are currently estimated to be 400 billion cubic feet. After examining all of the pertinent subsurface and geophysical information at our disposal, we estimate that with normal development drilling, the ultimate reserve to be recovered from these fields will be approximately two trillion cubic feet, or five times the present proven reserve. This represents a potential reserve per single-well gas field of about 50 billion cubic feet.

Assuming that this ratio can be applied to the total of 200 single-well fields, potential reserves of 10 trillion cubic feet might be assigned these fields.

An estimate has been prepared of the gas volumes required to supply Canadian and export needs to 1982 at current (1957) rates of consumption, allowing for an initial build-up period for Westcoast and Trans-Canada. A table summarizing this requirement is as follows:

	Total Requirements 1958 - 1982 (trillions of cubic feet)
Province of Alberta	2.89
Province of Saskatchewan	0.30
Montana, Saskatchewan Power and Peace River Transmission deliveries from Alberta	0.53
Trans-Canada deliveries from Alberta	4.92
Westcoast deliveries from Alberta and British Columbia	4.10
Total	12.74

As indicated in the table above, 12.74 trillion cubic feet is the volume of gas necessary to meet Alberta's 25 year needs at current consumption rates plus exports from Alberta and British Columbia. When this volume is deducted from present Canadian marketable gas reserves of 27.5 trillion cubic feet, there remains a present surplus of 14.8 trillion cubic feet.

While portions of this gas will be required in future years to meet increasing Canadian demand, until additional markets are established its future disposition remains uncertain.

We endorse the generally accepted methods currently employed for the determination of proven reserves. It is our contention, however, that it is not realistic to ignore reserve growth potential to meet long term requirements and to appraise the adequacy of reserves to meet these requirements solely on the basis of proven reserves.

Experience in the United States during the period 1920 to 1957 has indicated a phenomenal growth of gas reserves. Even with the present demand of 10 trillion cubic feet per year, the remaining life of reserves today is in excess of the remaining life in 1920.

This experience has demonstrated that an adequate market incentive will assure the development of gas reserves in quantities more than sufficient to meet an increasing demand.

British American is of the opinion that the most realistic approach to an appraisal of the adequacy of gas reserves to meet future needs is to relate such needs to the trend in the growth of reserves.

CONCLUSION

Our conclusion from studies made by British American on this whole subject may be summarized as follows:

In determining volumes of gas which can be made available for export, it is unrealistic to ignore potential growth, and to appraise the adequacy of reserves to meet future needs solely on the basis of present proven reserves.

The industry has already established an impressive growth rate from an exploration program directed mainly to the search for oil, and with a minimum of incentive for gas development.

In view of the fact that the geological environment in Western Canada is so favourable for further discoveries, we are of the opinion that the only realistic method of providing for estimated long-term needs is to relate such needs to the potential growth in reserves.

Canada, has, at the present time, and if the proper market incentive is provided, will continue to have in the future, surpluses of gas available for export, after adequate provision has been made for her own requirements.

Consideration should therefore be given to permitting the export of additional volumes of gas at the earliest possible date.

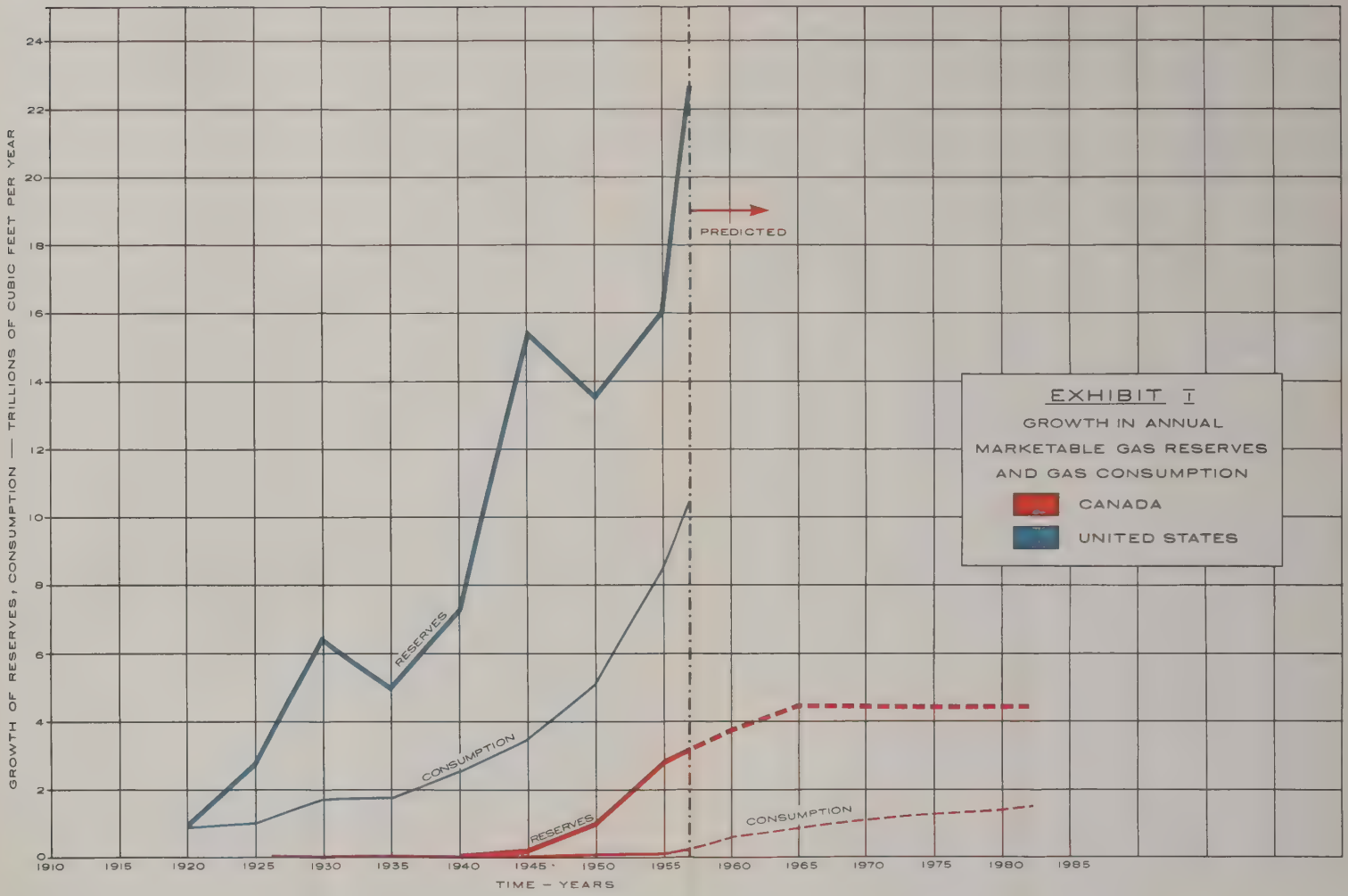
EXHIBIT I
GROWTH IN ANNUAL
MARKETABLE GAS RESERVES
AND GAS CONSUMPTION
CANADA
UNITED STATES
PREDICTED
RESERVES
CONSUMPTION
RESERVES
CONSUMPTION
GROWTH OF RESERVES, CONSUMPTION — TRILLIONS OF CUBIC FEET PER YEAR
0
2
4
6
8
10
12
14
16
18
20
22
24
1910
1915
1920
1925
1930
1935
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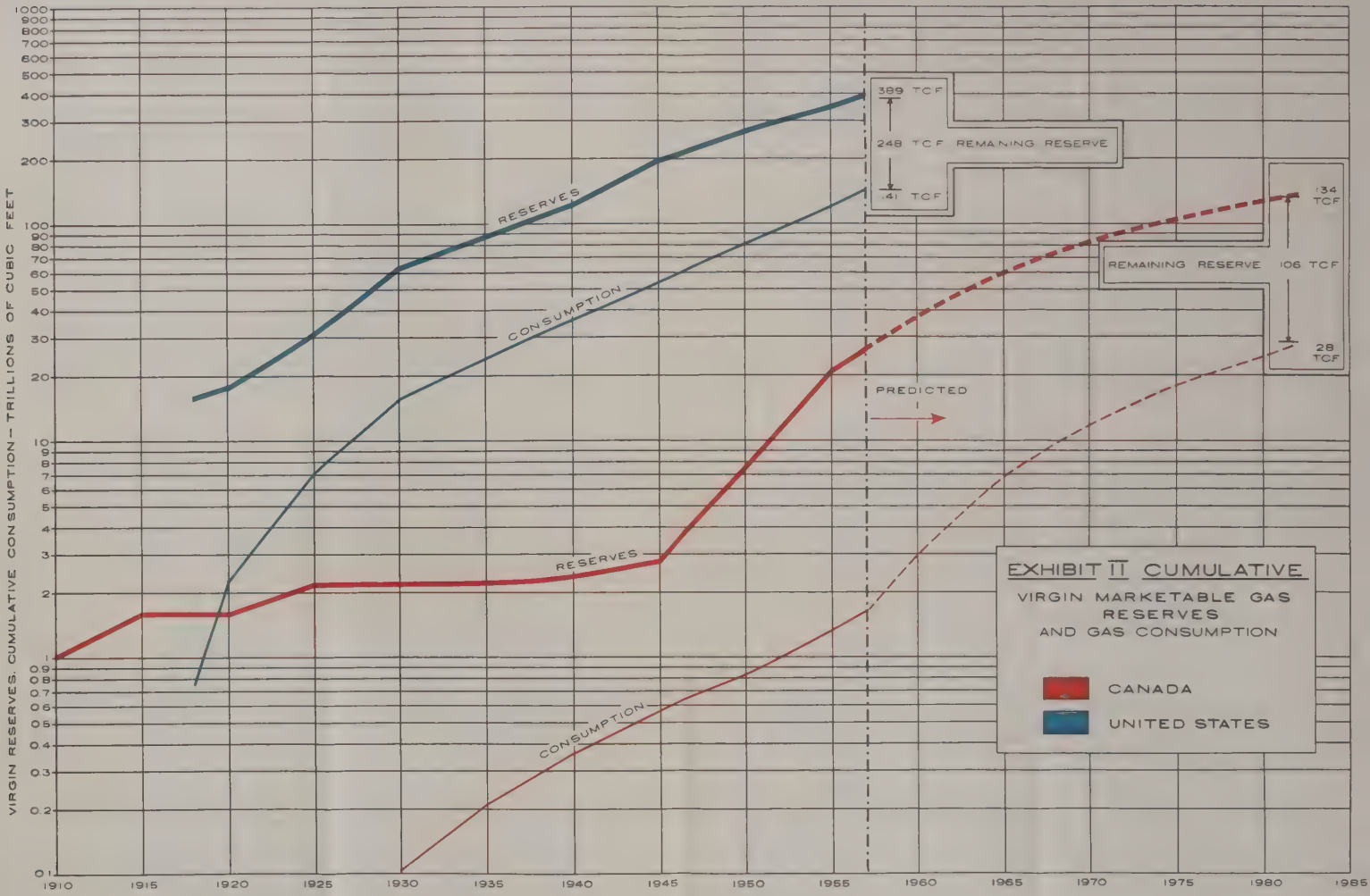
1950
1955
1960
1965
1970
1975
1980
1985
TIME — YEARS


VIRGIN RESERVES, CUMULATIVE CONSUMPTION – TRILLIONS OF CUBIC FEET
1000
900
800
700
600
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400
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3
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0.7
0.6
0.5
0.4
0.3
0.2
0.1
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
RESERVES
CONSUMPTION
PREDICTED
389 TCF
248 TCF REMAINING RESERVE
41 TCF
134 TCF
REMAINING RESERVE 106 TCF
28 TCF
RESERVES
CONSUMPTION
EXHIBIT II CUMULATIVE
VIRGIN MARKETABLE GAS RESERVES
AND GAS CONSUMPTION
CANADA
UNITED STATES

GROWTH OF VIRGIN GAS RESERVES AND CONSUMPTION IN U.S.A.

Year	Virgin Reserve (trillion cu. ft.)	Annual Reserve Growth (trillion cu. ft.)	Cumulative Consumption (trillion cu. ft.)	Annual Consumption (billion cu. ft.)
1918	15.72	—	0.72	—
1920	17.27	0.757	2.27	.757
1925	30.03	2.552	7.03	.952
1930	61.22	6.238	15.22	1.638
1935	85.72	4.900	23.72	1.700
1940	120.74	7.004	35.74	2.404
1945	196.93	15.238	52.64	3.380
1950	263.69	13.352	78.10	5.092
1955	343.79	16.020	120.09	8.398
1957	389.09	22.650	140.81	10.360

Note: Annual reserve growth and annual consumption data shown above represent 5-year averages.

References:

1. 20th Century Petroleum Statistics, 1956, published by DeGoyler and MacNaughton, Dallas, Texas.
2. 1957 figures from Oil and Gas Journal, January 27, 1958.

GROWTH OF VIRGIN GAS RESERVES AND CONSUMPTION IN CANADA

Year	Virgin Reserve (trillion cu. ft.)	Annual Reserve Growth (trillion cu. ft.)	Annual Consumption (billion cu. ft.)	Cumulative Consumption (trillion cu. ft.)
1910	1.0	0.01		
1915	1.6	0.12		
1920	1.6	—		
1925	2.2	—		
1930	2.2	—	21.4	0.107
1935	2.2	—	21.4	0.214
1940	2.35	0.03	30.8	0.368
1945	2.82	0.094	42.0	0.578
1950	7.62	0.960	54.4	0.850
1955	21.60	2.805	103.2	1.366
1960	37.20	3.120	584.5	3.087
1965	59.20	4.400	872.8	6.963
1970	81.20	4.400	1085.7	12.010
1975	103.20	4.400	1282.2	17.984
1980	125.20	4.400	1393.4	24.853
1982	134.00	4.400	1489.8	27.777

Note: Annual reserve growth and past consumption data shown above represent 5 year averages.

References:

1. Past consumption of natural gas in Canada from ''Canadian Energy Prospects'' by John Davis, March, 1957, prepared for the Royal Commission on Canada's Economic Prospects. Past consumption figures exclude field waste and other losses.

2. Past reserves of Canada based on Alberta Conservation Board figures up to 1948. Thereafter, reserves for all Provinces have been included, using C.P.A. references and paper - ''Natural Gas Resources of the Peace River Area'' by G. S. Hume.

3. (a) Future consumption for Alberta based on Oil and Gas Conservation Board report - ''Natural Gas Reserves'', January 31, 1957.

   (b) Future consumption via Trans-Canada Pipe Line based on report - ''Present and Potential Canadian and Export Natural Gas Markets of Trans-Canada Pipe Lines Limited'' - February, 1958, prepared by Commonwealth Services Inc.

   (c) Future consumption via Westcoast Transmission Company Limited based on submission of Westcoast to the Royal Commission on Energy, February, 1958, plus British American estimate of British Columbia consumption after 1962.

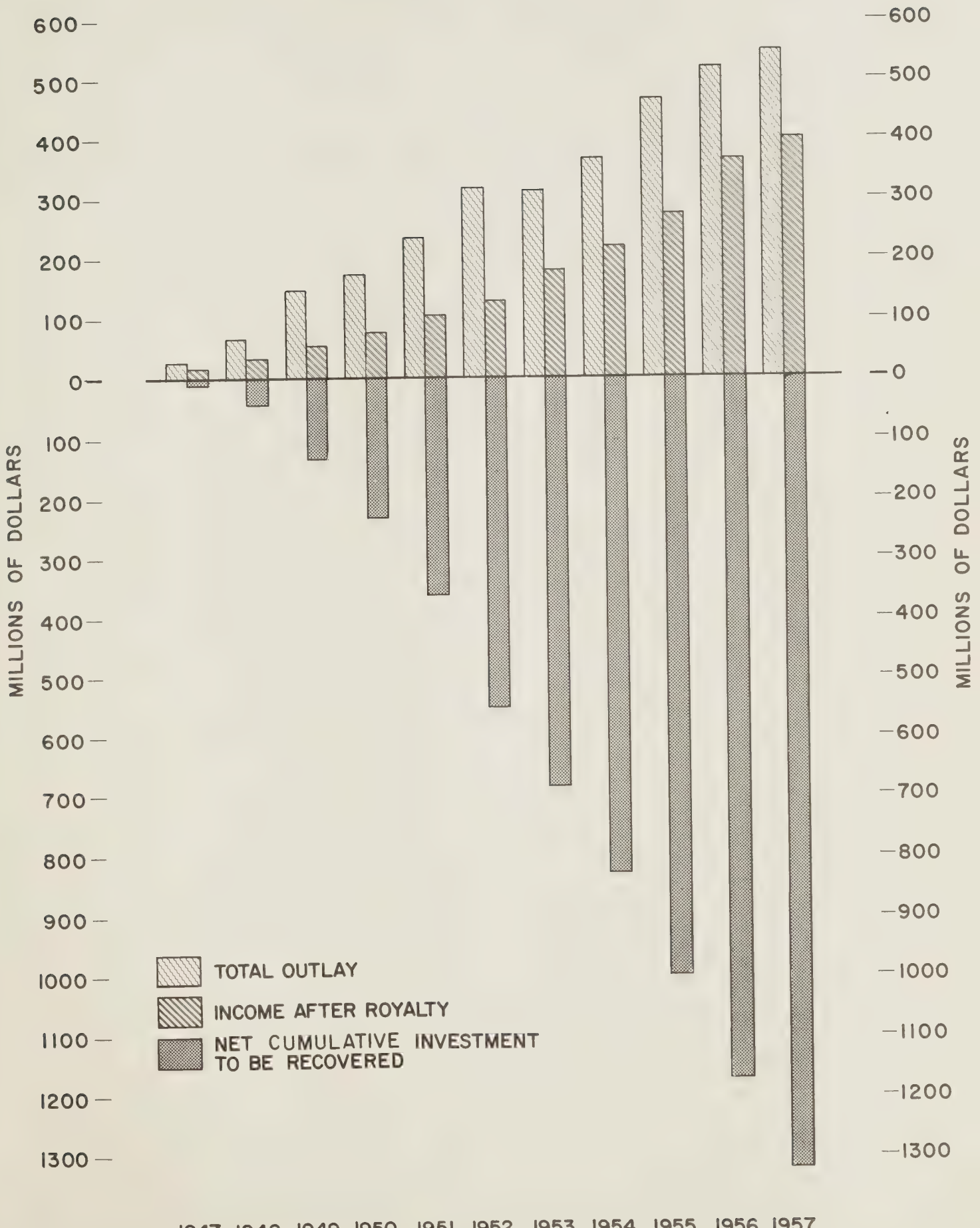
ESTIMATED EXPENDITURES AND INCOME
EXPLORATION AND DEVELOPMENT ACTIVITY - WESTERN CANADA
YEARS 1947 - 1957

(except per barrel figures which are expressed in dollars)
THOUSANDS OF DOLLARS

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	Cumulative 1947 through 1957
OUTLAY												
Exploration Costs												
Land Acquisitions & Rentals	$ 1,900	$ 13,600	$ 34,900	$ 48,700	$ 36,400	$ 45,500	$ 54,300	$ 105,400	$ 99,300	$ 133,300	$ 150,000	$ 723,300
Geological & Geophysical	6,400	17,400	30,800	34,900	65,600	80,500	72,800	64,500	62,600	54,800	53,500	543,800
Wildcat Drilling	8,100	18,500	40,800	20,300	39,300	56,200	57,000	73,700	88,500	104,800	101,900	609,100
Sub-Total	16,400	49,500	106,500	103,900	141,300	182,200	184,100	243,600	250,400	292,900	305,400	1,876,200
Development Drilling	5,900	12,000	32,400	57,500	74,800	111,600	97,900	84,700	165,500	159,800	159,100	961,200
Production Expense	3,100	4,900	8,300	11,400	18,500	23,700	31,300	37,200	50,000	66,000	82,900	337,300
TOTAL OUTLAY	25,400	66,400	147,200	172,800	234,600	317,500	313,300	365,500	465,900	518,700	547,400	3,174,700
- Per Barrel Produced	3.17	5.25	6.71	5.77	4.77	5.05	3.78	3.72	3.52	2.96	2.95	3.70
INCOME												
Value of Production												
Crude Oil	18,700	36,200	59,900	83,300	115,600	142,000	199,200	242,100	302,800	405,000	443,800	2,048,600
Natural Gas	2,500	2,200	2,600	3,000	3,600	6,100	6,900	8,400	10,600	12,100	14,000	72,000
Sub-Total	21,200	38,400	62,500	86,300	119,200	148,100	206,100	250,500	313,400	417,100	457,800	2,120,600
Less: Royalty Payments	3,300	5,600	7,800	10,800	14,900	18,500	25,800	31,300	39,200	52,100	57,200	266,500
INCOME AFTER ROYALTY	17,900	32,800	54,700	75,500	104,300	129,600	180,300	219,200	274,200	365,000	400,600	1,854,100
- Per Barrel Produced	2.23	2.59	2.49	2.52	2.12	2.06	2.18	2.23	2.07	2.08	2.16	2.16
NET INVESTMENT TO BE RECOVERED	$ 7,500	$ 33,600	$ 92,500	$ 97,300	$ 130,300	$ 187,900	$ 133,000	$ 146,300	$ 191,700	$ 153,700	$ 146,800	$ 1,320,600
- Per Barrel Produced	$ 0.94	$ 2.66	$ 4.22	$ 3.25	$ 2.65	$ 2.99	$ 1.60	$ 1.49	$ 1.45	$ 0.88	$ 0.79	$ 1.54

NOTE: (1) This estimate has been prepared by British American based on Provincial and Federal Government, Industry and Company publications.
(2) The above estimate does not include any outlay for gas gathering and gas processing facilities, or pipe lines.
(3) See Figure 1 attached.

ESTIMATED EXPENDITURES AND INCOME
EXPLORATION AND DEVELOPMENT ACTIVITY - WESTERN CANADA
YEARS 1947 - 1957



APPENDIX

ULTIMATE HYDROCARBON RESERVES IN WESTERN CANADA SEDIMENTARY BASIN

The Western Canada Sedimentary Basin (Figure 1) encompasses that portion of Canada lying between the Precambrian Canadian Shield on the east and the Cordillera on the west, the 49th Parallel on the south and the Arctic Ocean on the north. This region is almost synonymous with the term Interior Plains, but also includes the foothills belt and the Intermontane basin of the Cordillera. It excludes the Arctic Archipelago.

Within this basin, 602,000 square miles are considered favourable for oil and gas exploration. (Table 1.) This area is underlain by approximately 789,000 cubic miles of favourable sediments lying west of the 1,000 foot isopach. Within this area, the base is the Precambrian basement, or a maximum depth of 20,000 feet.

The Western Canada Sedimentary Basin is the most important petroleum region in Canada, not only because of the large reserves of oil and gas that have already been discovered within its boundaries in a very short time, but because of the large volume of prospective sediments and the presence of many types of traps considered favourable for oil and gas accumulation.

The Western Canada Sedimentary Basin is the northern extension of the Mid-Continent region of the United States. (Figure 2). As these two areas have a similar geological history and the same conditions for the entrapment of hydrocarbons, they are regarded geologically as one petroleum province.

The ultimate reserves of petroleum and natural gas for Western Canada were determined by comparing this region with the volume of sediments, reserves, and exploration history of the more heavily explored Mid-Continent portion of this petroleum province. This method, described by L. G. Weeks,[1] consists of relating ultimate reserves to the volume of favourable sediments and the exploratory effort.

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1 Weeks, L. G. "Concerning Estimates of Potential Oil Reserves", Bull. Amer. Assoc. Petrol. Geol. Volume 34, No. 10, pp. 1947-1953 (1950).

Up to December 31, 1957, the Mid-Continent region had found average virgin reserves[1] of 63,575 barrels of liquid hydrocarbons and 254 million cubic feet of virgin reserves of natural gas per cubic mile of favourable sediments. The ultimate recoverable reserves predicted for the entire continental United States are approximately three times the present day virgin reserves.[2] [3] Applying this "Ultimate Reserve Factor"[4] of three to the Mid-Continent results in ultimate virgin reserves of 190,725 barrels of liquid hydrocarbons and 763 million cubic feet of natural gas per cubic mile of prospective sediments in this region.

Similarly, the ultimate virgin reserves of gas, natural gas liquids,[5] and crude oil have been determined by two steps for the Western Canada Sedimentary Basin.

First, this was done by analyzing portions of this basin and estimating the proven reserves within them when an exploratory effort equivalent to the current Mid-Continent exploratory level was reached. (This estimate took into consideration geologic history, volume and type of sediments, and present virgin reserves.)

Second, an "Ultimate Reserve Factor" was then applied to each portion. This Factor is approximately equal to two for the whole of Western Canada, and is considered extremely conservative compared to the figure of three commonly used for the United States. Thus, ultimate virgin reserves were determined for the Western Canada Sedi-

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1 Virgin reserves are defined as the sum of cumulative production and proven and probable recoverable reserves.

2 The current total virgin reserves for the United States are 91 billion barrels of liquid hydrocarbons and 400 trillion cubic feet of gas. The ultimate total virgin reserves are estimated by eminent authorities to be between 210 billion and 300 billion barrels of liquid hydrocarbons and 1,200 trillion cubic feet of natural gas.

3 Hill, K. E., Hammer, H. D., and Winger, J. G., ''Future Growth of the World Petroleum Industry'', the Chase Manhattan Bank, New York, pp. 27-29 (1957).

4 ''Ultimate Reserve Factor'' is defined as the ratio of ultimate virgin reserves to present virgin reserves.

5 All reserves and reserve growth were estimated using total liquid hydrocarbons. The reserves of natural gas liquids were determined by using the present day ratios of natural gas liquids to natural gas, in barrels per million cubic feet, for the various portions of the Western Canada Sedimentary Basin, and applying these ratios to the predicted reserves of natural gas. Reserves of natural gas liquids obtained in this manner were subtracted from the estimated reserves of total hydrocarbons to obtain ultimate virgin reserves of crude oil.

mentary Basin of 69,380 barrels of liquid hydrocarbons and 390 million cubic feet of gas per cubic mile of sediments.

Therefore, the total ultimate virgin reserves for the Western Canada Sedimentary Basin, exclusive of the McMurray oil sands, determined by this Company are as follows:

	Ultimate
Natural Gas[1]	308 trillion cubic feet
Natural Gas Liquids	6.3 billion barrels
Crude Oil	48.4 billion barrels

The petroleum industry in Western Canada has a present virgin reserve of some 33.2 trillion cubic feet of natural gas. This is an impressive total when it is considered that exploration of this vast and potentially prolific region is still in its infancy.

At the present time, the industry has drilled one exploratory test[2] for every 111 cubic miles of prospective sediments. When this is compared with a density of approximately one exploratory test for every 7.5 cubic miles of favourable sediments in the continental United States, it is immediately apparent that the Western Canada Sedimentary basin is still comparatively untapped.

The paucity of exploration is even more apparent when it is considered that the three prairie provinces, the area of most concentrated drilling to date, contains 6,200 townships out of a total of 11,050, or more than 55 per cent of the townships that do not have a test of any description within their boundaries. In addition, only the upper portion of the stratigraphic column has been explored by drilling. Less than 400 wells out of a total of 22,500 wells have penetrated the entire sedimentary section to the Pre-Cambrian.

As of December 31, 1957, virgin producible natural gas reserves of 4.6 billion cubic feet per exploratory well had been discovered in

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1 Reference: Table II

2 An exploratory test is defined as any well that is drilled in search of new and as yet undiscovered pools or in search of long extensions of pools already discovered.

Western Canada. This is approximately 2.5 times the U.S. discovery rate of 1.85 billion cubic feet per exploratory well. Assuming reasonable incentives exist, it is estimated that 25,000 exploratory wells will be drilled in Western Canada during the next 25 years. This represents an average rate of 1,000 exploratory tests per year.

The history of the U.S., particularly the Mid-Continent, has shown no appreciable decline in the discovery of additional natural gas reserves over the past 30 years. Therefore, we have assumed that the present rate at which each exploratory well in Western Canada adds to our gas reserves will also remain reasonably constant, and will result in total virgin reserves of 150 trillion cubic feet of natural gas by 1982.

A brief appraisal of the gas potential of each of the geological regions of the Western Canada Sedimentary Basin is as follows: Present virgin gas reserves of Manitoba and Saskatchewan are small, and are indicative of a relatively small ultimate potential of this region. Most of the gas will be found in Western Saskatchewan or in pre-Devonian beds in southern Saskatchewan.

The Alberta Plains are sub-divided into the Sweetgrass Arch area of Alberta, Alberta Basin, Peace River Arch and Basin, and northern Alberta.

It is expected that considerable gas will be found in southern Alberta (Sweetgrass Arch area) in the near future as the intensity of exploration is increased. This area has, at best, been only scantily explored in relation to the southern part of the Alberta Basin.

In the southern part of the Alberta Basin, considerably more gas will be found, particularly from the Mesozoic sediments of the eastern portion of the province and from the Cretaceous, Mississippian and Devonian of the western part. The northern part of the Alberta Basin is relatively unexplored and the potentials of this area are great, both from the Palaeozoics and Mesozoics.

To date the Peace River Arch and vicinity have been noted largely for the occurrence of gas. This area is relatively unexplored and considerable quantities of gas should be found. Exploration in the Northern Alberta Basin, although in its infancy, has yielded ample evidence of gas. The thick favourable sediments within this basin suggest a vast amount of gas will be discovered.

In the Alberta Foothills, the major gas fields found to date all lie within the southern foothills. Of these fields, Jumping Pound, Turner Valley, and Pincher Creek account for about 20 per cent of the virgin gas reserves. The Central Foothills Area has just come into prominence, and recent discoveries such as Stolberg, Lovett River and Panther Dome indicate a great potential for this part of the foothills.

The northern foothills of Alberta are unexplored to date and large reserves of gas undoubtedly occur as the sediments and structures are similar to those both south and north.

The deep and difficult drilling and heavy exploration programs required add to foothills costs, but the attraction of thick pay sections in giant structures will result in an acceleration of exploration activity in the foothills area. We feel the gas reserves of the foothills will be increased to 51.6 trillion cubic feet.

Numerous gas fields have been discovered in the Mesozoic and Palaeozoic in the Fort St. John area of northeastern British Columbia, although the area has only been lightly explored. The northernmost part of British Columbia plains have been tested by only a few exploratory tests, but gas in large quantities has been found as far north as Fort Nelson. Inasmuch as the types of sediments are favourable and the thicknesses are great, a large number of gas discoveries will be made.

The intensity of exploration effort will slowly increase throughout northeastern British Columbia and, we feel, should reach its peak about 1985.

The Northwest Territories and Yukon are relatively unknown as to their potentials. Their geographical position, distance from markets and lack of detailed geological data have forced us to downgrade this area but the Territories do hold great promise. However, improved equipment, new roads and other facilities are helping to overcome the obstacles. Exploration in the Territories should reach its highest intensity in the period after 1990.

In conclusion, we feel that this estimate of virgin reserves is conservative. These reserves will be increased as the quality of exploration and the means of recovering oil are improved through technical advancement. The point in time at which these ultimate reserves will be attained is difficult to determine since it is governed by economics, exploratory methods, and many other intangible factors.

WESTERN CANADA SEDIMENTARY AREA

Area & Volume of Sediments

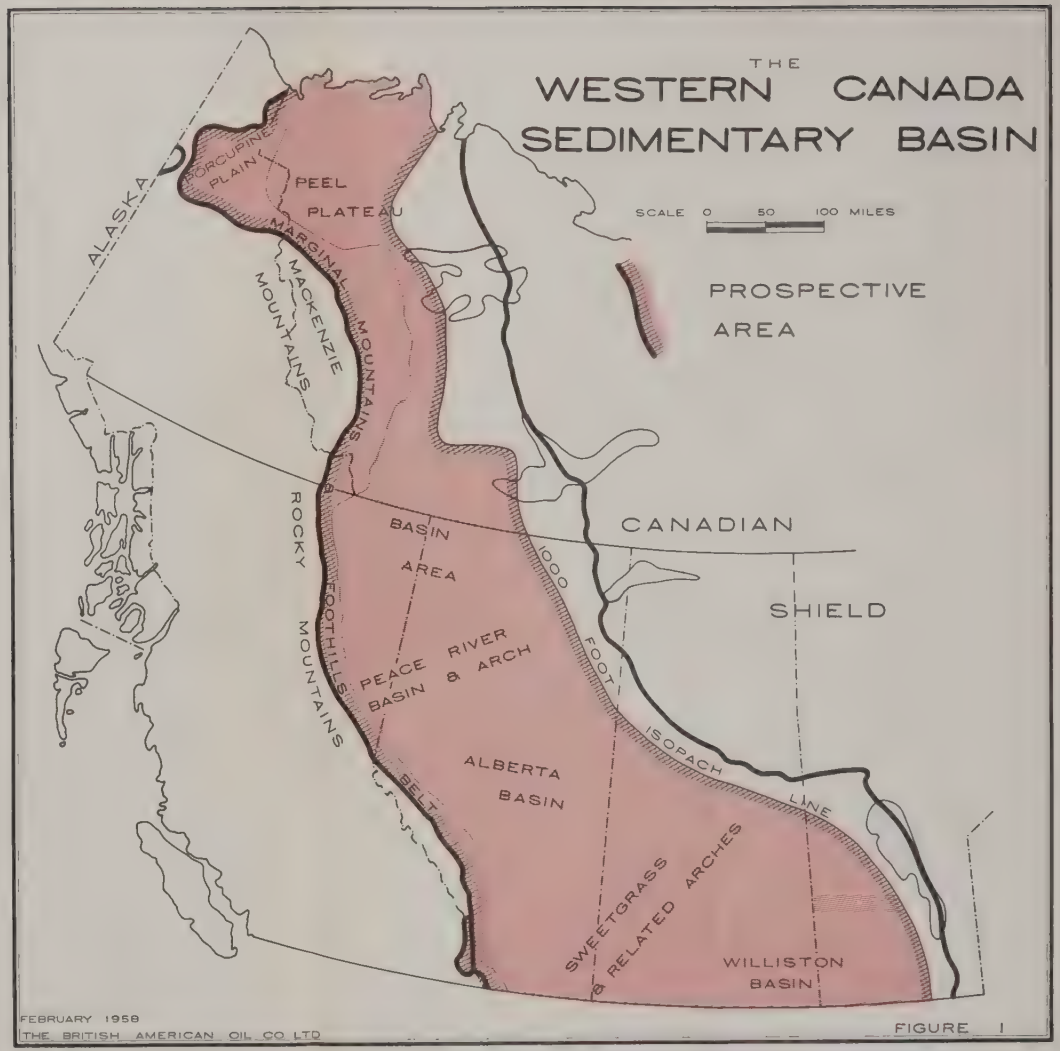
Area	Total Area Square Miles	Prospective Area (1) Square Miles	Prospective Area Volume Favourable Sediments in Cubic Miles (2)
Manitoba & Saskatchewan	234,677	181,813	164,011
Alberta Plains	225,549	210,068	287,110
Alberta Foothills	13,301	13,301	49,168
Northeast British Columbia	51,252	51,252	125,765
Yukon & Northwest Territories	228,546	145,369	163,112
Western Canada Total	753,325	601,803	789,166

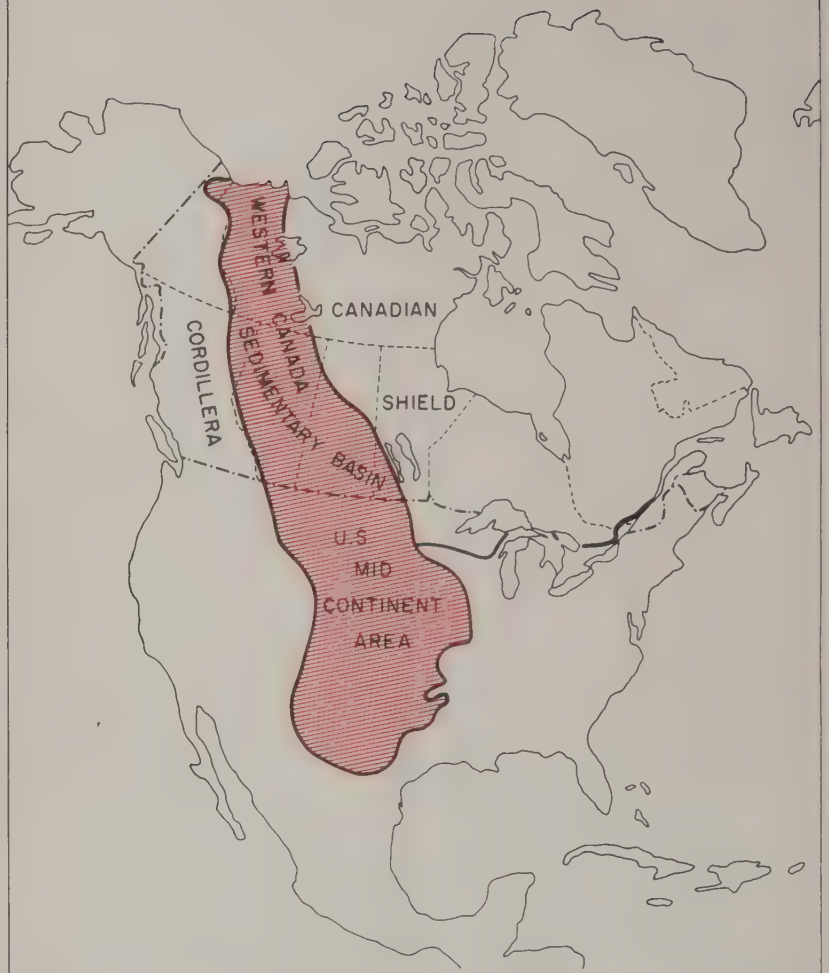
(1) Prospective Area: Area where sediments are thicker than 1,000 feet.

(2) Volume of Sediments: Sediments of prospective area to a maximum of 20,000 feet.

WESTERN CANADA SEDIMENTARY BASIN
Estimated Producible Reserves of Natural Gas

Area	Volume Favourable Sediments In Cubic Miles	Total Virgin Reserves Dec. 31, 1957 Millions of Cubic Feet	Est. Producible Reserves End 1982 Millions of Cubic Feet	Ultimate Producible Reserves - Millions of Cubic Feet
Manitoba & Saskatchewan	164,011	1,138,509	4,000,000	4,800,000
Alberta Plains	287,110	21,988,863	70,000,000	143,700,000
Alberta Foothills	49,168	7,607,342	40,000,000	51,800,000
Northeast British Columbia	125,765	2,470,580	35,000,000	89,100,000
Yukon & Northwest Territories	163,112	59,979	1,000,000	19,000,000
Western Canada Total	789,166	33,265,273	150,000,000	308,400,000
Mid-Continent Region Total	780,000	198,434,000		595,290,000


THE
WESTERN CANADA
SEDIMENTARY BASIN
SCALE 0 50 100 MILES
PROSPECTIVE AREA
ALASKA
PORCUPINE PLAIN
PEEL PLATEAU
MARGINAL MOUNTAINS
MACKENZIE MOUNTAINS
ROCKY MOUNTAINS
FOOTHILLS BELT
BASIN AREA
1000 FOOT ISOBACH LINE
CANADIAN SHIELD
PEACE RIVER BASIN & ARCH
ALBERTA BASIN
SWEETGRASS & RELATED ARCHES
WILLISTON BASIN
FEBRUARY 1958
THE BRITISH AMERICAN OIL CO LTD
FIGURE 1



WESTERN CANADA SEDIMENTARY BASIN

AND

U.S. MID CONTINENT AREA

THE BRITISH AMERICAN OIL CO. LTD.

FIGURE 2.